Sealed Branch Wellbore Transition Joint

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SEALED BRANCH WELLBORE TRANSITION JOINT

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BACKGROUND

The present invention relates generally to operations performed and equipment utilized in conjunction with a subterranean well and, in an embodiment described herein, more particularly provides a sealed branch wellbore transition joint.

A transition joint is used in completing some multilateral wells, for example, in TAML "Level 3" multilateral completions. As the name implies, the transition joint provides a useful transition between a parent wellbore and a branch wellbore drilled outwardly from the parent wellbore.

Unfortunately, it is a difficult problem to seal off a formation surrounding the intersection between the parent and branch wellbores from the parent wellbore. Where a sufficient seal is not provided, formation fines and sand can make their way into the parent wellbore, where they can plug or erode production equipment and cause other problems.

Therefore, it may be seen that it would be beneficial to provide improved well completion systems and methods. Such systems and methods could include an improved sealed branch wellbore transition joint.

SUMMARY

In carrying out the principles of the present invention, in accordance with an embodiment thereof, a sealed branch wellbore transition joint is provided for use in well completion systems and methods. A swelling sealing material is preferably used on the transition joint in order to seal off a formation surrounding an intersection between parent and branch wellbores.

In one aspect of the invention, a method of completing a well having a branch wellbore extending outwardly from a window in a parent wellbore is provided. The method includes the steps of: positioning an assembly in the window; and swelling a sealing material on the assembly. A seal is formed between the assembly and the window by the swelling sealing material.

In another aspect of the invention, a completion system for a well having a branch wellbore extending outwardly from a window in a parent wellbore is provided. The system includes a tubular string having a portion positioned within the window, and a sealing material on the tubular string portion. The sealing material swells in the well to thereby form a seal between the tubular string portion and the window.

In yet another aspect of the invention, a completion system for a well having a branch wellbore extending outwardly from a window in a parent wellbore includes an assembly positioned in the parent wellbore, the assembly having an opening formed through a sidewall thereof. The opening is aligned with the window. A sealing material is positioned on the assembly. The sealing material swells in the well to thereby form a seal circumferentially about the opening.

In a further aspect of the invention, a method of completing a well having a branch wellbore extending outwardly from a window in a parent wellbore includes the steps of: positioning an assembly in the parent wellbore; forming an opening through a sidewall of the assembly; aligning the assembly with the window; and swelling a sealing material on the assembly, so that a seal is formed about the opening.

These and other features, advantages, benefits and objects of the present invention will become apparent to one of ordinary skill in the art upon careful

consideration of the detailed description of representative embodiments of the invention hereinbelow and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic partially cross-sectional view of a first well completion system embodying principles of the present invention;

FIG. 2 is a schematic partially cross-sectional view of the first system, wherein a branch wellbore transition joint has been sealed;

FIG. 3 is a schematic partially cross-sectional view of a second well completion system embodying principles of the present invention; and

FIG. 4 is a schematic partially cross-sectional view of the second system, wherein an intersection between wellbores has been sealed.

DETAILED DESCRIPTION

Representatively illustrated in FIG. 1 is a well completion system 10 which embodies principles of the present invention. In the following description of the system 10 and other apparatus and methods described herein, directional terms, such as "above", "below", "upper", "lower", etc., are used for convenience in referring to the accompanying drawings. In particular, the term "above" means relatively closer to the earth's surface along a wellbore, and the term "below"

means relatively farther from the earth's surface along a wellbore. Additionally, it is to be understood that the various embodiments of the present invention described herein may be utilized in various orientations, such as inclined, inverted, horizontal, vertical, etc., and in various configurations, without departing from the principles of the present invention.

As depicted in FIG. 1, a main or parent wellbore 12 has been drilled, and then lined with protective casing 14. The parent wellbore 12 may extend continuously to the earth's surface, or it may be a branch of another wellbore. It is not necessary in keeping with the principles of the invention for the parent wellbore 12 to be cased, since it could be completed open hole if desired. If the parent wellbore 12 is cased, then the wellbore can be considered the interior of the casing 14.

A branch wellbore 16 is drilled extending outwardly from a window 18 formed through a sidewall of the casing 14. The window 18 can be formed before or after the casing 14 is installed in the parent wellbore 12. For example, the window 18 could be formed by anchoring a whipstock (not shown) in the casing 14, and then deflecting a mill laterally off of the whipstock to cut the window through the casing sidewall.

A formation or zone 20 surrounds the intersection between the parent and branch wellbores 12, 16. In order to seal off the formation 20 from the interior of the parent wellbore 12, while also providing a useful transition between the parent and branch wellbores 12, 16, an assembly 22 is positioned in the window

18. The assembly 22 is depicted in FIG. 1 as including a tubular string 24 having a transition joint 26 interconnected therein.

A lower end of the tubular string 24 is deflected into the branch wellbore 16, for example, by using a whipstock or other deflector positioned in the parent wellbore 12. The tubular string 24 could be cemented in the branch wellbore 16, if desired.

The transition joint 26 has an opening 28 formed through a sidewall thereof. The opening 28 may be formed in the sidewall of the transition joint 26 before or after the transition joint is installed in the well. The opening 28 provides fluid communication (and preferably access) between an interior of the tubular string 24 and the parent wellbore 12 external to the tubular string below the window 18.

A sealing material 30 is provided on the transition joint 26. Preferably, the sealing material 30 is provided in the form of a coating adhered externally to the transition joint 26. However, other methods of attaching the sealing material 30 to the transition joint 26 may be used in keeping with the principles of the invention.

The sealing material 30 swells when exposed to fluid in the well. Preferably, the sealing material 30 increases in volume and expands radially outward when a particular fluid contacts the sealing material in the well. For example, the sealing material 30 could swell in response to exposure to hydrocarbon fluid (such as oil or gas), or in response to exposure to water in the

well. The sealing material 30 could be made of a rubber compound, or it could be made of other materials.

Referring additionally now to FIG. 2, the system 10 is depicted after the sealing material 30 has swollen in the window 18. Note that a seal 32 is now formed by the swollen sealing material 30 between the transition joint 26 and the window 18. This seal 32 may be used to prevent fines, sand, etc. from migrating from the formation 20 into the parent wellbore 12. The tubular string 24 could be cemented in the branch wellbore 16 before or after the seal 32 is formed.

In addition, the swollen sealing material 30 can (but does not necessarily) provide another seal 34 between the transition joint 26 and the casing 14 in the parent wellbore 12. This seal 34 can be used as an annular barrier above the opening 28. Note that the opening 28 is conveniently positioned between the seals 32, 34 for providing fluid communication between the interior of the tubular string 24 and the parent wellbore 12 below the window 18.

Referring additionally now to FIG. 3, another completion system 40 embodying principles of the invention is representatively illustrated. The system 40 is similar in many respects to the system 10 described above, and so elements of the system 40 which are similar to those described above are indicated in FIG. 3 using the same reference numbers.

The system 40 differs from the system 10 in at least one significant respect in that, instead of positioning the tubular string 24 in the parent and branch wellbores 12, 16, an assembly 42 is positioned in the parent wellbore opposite the

window 18. The assembly 42 includes a tubular structure 44 having the sealing material 30 externally secured thereto. In addition, a tubular string 46, such as a liner string, is positioned in the branch wellbore 16.

The tubular string 46 is preferably positioned in the branch wellbore 16 prior to positioning the assembly 42 in the parent wellbore 12. The tubular string 46 may be cemented in the branch wellbore 16, for example, between the window 18 and a packer 48 set in the branch wellbore, or the tubular string may be otherwise cemented or left uncemented in the branch wellbore. An upper end 50 of the tubular string 46 may extend to the parent wellbore 12, where it may be cut off, such as by use of a washover tool, etc.

When the assembly 42 is positioned in the parent wellbore 12, it may have an opening 52 formed through its sidewall. This opening 52 may be rotationally aligned with the window 18 by engagement between a latch 54 of the assembly 42 and an orienting profile 56 of the casing string 14. This engagement may also anchor the assembly 42 in the casing string 14.

Alternatively, the opening 52 could be formed after the assembly 42 has been positioned in the parent wellbore 12. For example, a deflector (such as a whipstock) could be secured in the assembly 42 and used to deflect a cutting tool (such as a mill) to form the opening 52 through the assembly sidewall after the assembly is anchored in the casing string 14. Furthermore, the opening 52 could be formed through the sidewall of the assembly 42 after the sealing material 30 has swelled.

Referring additionally now to FIG. 4, the system 40 is representatively illustrated after the sealing material 30 has swelled. The sealing material 30 may be swollen by exposure to fluid in the well, such as hydrocarbon fluid or water, etc. A volume of the sealing material 30 increases as it swells.

A sealed flowpath 58 is now provided between the branch wellbore 16 and the parent wellbore 12 through an interior of the assembly 42. This flowpath 58 is isolated from the formation 20 surrounding the intersection between the parent and branch wellbores 12, 16.

Specifically, the sealing material 30 now forms a seal 60 between the assembly 42 and the interior of the casing string 14 circumferentially about the opening 52 and circumferentially about the window 18. The sealing material 30 also preferably sealingly engages the upper end 50 of the tubular string 46 and seals circumferentially thereabout. In addition, the swollen sealing material 30 forms an annular seal 62 between the tubular structure 44 and the interior of the casing string 14 both above and below the window 18.

Of course, a person skilled in the art would, upon a careful consideration of the above description of a representative embodiment of the invention, readily appreciate that many modifications, additions, substitutions, deletions, and other changes may be made to this specific embodiment, and such changes are contemplated by the principles of the present invention. Accordingly, the foregoing detailed description is to be clearly understood as being given by way of

illustration and example only, the spirit and scope of the present invention being limited solely by the appended claims and their equivalents.